

PART-I : PHYSICS

1) In a hypothetical set of units

1 star joule = 10^3 joule

1 star Newton = 10^4 Newton

1 star second = 10 second

Then one meter is equivalent to

(1) 100 star meter

(2) 1000 star meter

(3) 10 star meter

(4) $\frac{1}{10}$ star meter

2) The length of a rectangular sheet is 1.5 cm and breadth is 1.203 cm. The area of the face of rectangular sheet to the correct number of significant figures is :

(1) 1.8045 cm^2

(2) 1.804 cm^2

(3) 1.805 cm^2

(4) 1.8 cm^2

3) If $\vec{P}$ & $\vec{Q}$ are perpendicular to each other, the rectangular component of $(\vec{P} + \vec{Q})$ along $(\vec{P} - \vec{Q})$ is given by:-

(1) $\frac{(P^2 - Q^2)(\vec{P} - \vec{Q})}{P^2 + Q^2}$

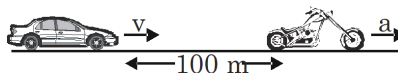
(2) $\frac{(P^2 + Q^2)(\vec{P} - \vec{Q})}{P^2 + Q^2}$

(3) $\frac{(P^2 - Q^2)(\vec{P} + \vec{Q})}{P^2 + Q^2}$

(4) $\frac{(P^2 + Q^2)(\vec{P} + \vec{Q})}{P^2 + Q^2}$

4) A man travelling in car with a maximum constant speed of 20 m/s watches his friend start off at a distance 100 m ahead on a motor cycle with constant acceleration 'a'. The maximum value of 'a' for

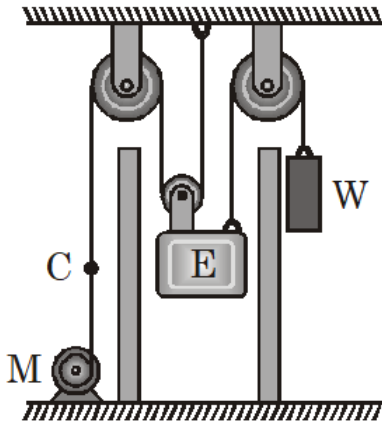
which the man in the car can reach his friend is :



(1) 2 m/s^2

- (2) 1 m/s^2
- (3) 4 m/s^2
- (4) None of these

5) The elevator E shown in the figure moves downward with a constant velocity of 15 ft/s . The relative velocity of the cable C with respect to the elevator is



- (1) 30 ft/sec
- (2) 45 ft/sec
- (3) 15 ft/sec
- (4) 60 ft/sec

6) A force $\vec{F} = (3t\hat{i} + 5\hat{j}) \text{ N}$ acts on a body due to which its displacement varies as $\vec{s} = (2t^2\hat{i} - 5\hat{j})$. Work done by this force in $t = 0$ to 2 sec is:

- (1) 23 J
- (2) 32 J
- (3) zero
- (4) can't be obtained

7) A heavy particle hanging from a string of length l is projected horizontally with speed $\sqrt{gl}$. The speed of the particle at the point where the tension in the string equals weight of the particle is:

- (1) $\sqrt{2gl}$
- (2) $\sqrt{3gl}$
- (3) $\sqrt{gl/2}$
- (4) $\sqrt{gl/3}$

8) A particle is moving in circle of radius R with constant angular acceleration α at the time when centripetal acceleration is $2\sqrt{2}$ times of tangential acceleration then net acceleration of particle is :-

- (1) $3R\alpha$
- (2) $2R\alpha$
- (3) $R\alpha$
- (4) $4R\alpha$

9) A car is moving along a circular track with tangential acceleration of magnitude a_0 . It just start to slip at speed v_0 then find radius of circle. (Coefficient of friction is μ)

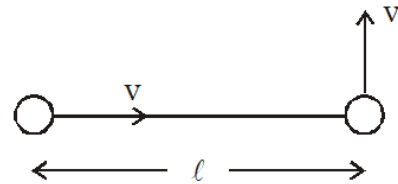
(1) $\frac{v_0^2}{\sqrt{(\mu g)^2 + a_0^2}}$

(2) $\frac{v_0^2}{\sqrt{(\mu g)^2 - a_0^2}}$

(3) $\frac{v_0^2}{\sqrt{(\mu g)^2 - 2a_0^2}}$

(4) $\frac{v_0^2}{\sqrt{(\mu g)^2 + 2a_0^2}}$

10) Two identical balls are interconnected with a light and inextensible thread having length l . The system is on a smooth horizontal table with the thread just taut. Initial velocities of both as shown.



The kinetic energy of the system after the string gets taut.

(1) mv^2

(2) $2mv^2$

(3) $\frac{3}{4} mv^2$

(4) $\frac{3}{2} mv^2$

11) Two circular discs A and B are of equals mass & thickness but made of metals with densities d_A & d_B ($d_A > d_B$). If their moments of inertia about an axis passing through centres & normal to the circular faces be I_A & I_B , then

(1) $I_A = I_B$

(2) $I_A > I_B$

(3) $I_A < I_B$

(4) None of these

12) In a simple hydraulic press, the cross-sectional area of the two cylinders are $5 \times 10^{-4} \text{ m}^2$ and 10^{-2} m^2 respectively. A force of 20N is applied at the small plunger. What is the pressure produced in the cylinders?

(1) $4 \times 10^2 \text{ N/m}^2$

(2) $4 \times 10^4 \text{ N/m}^2$

(3) $4 \times 10^6 \text{ N/m}^2$

(4) $4 \times 10^{11} \text{ N/m}^2$

13) A ring of a thin wire of cross-sectional area a and length l is dipped into a liquid of surface tension σ and taken out so that a film of liquid is formed in the ring. If young's modulus of material of wire is y then longitudinal strain developed in the ring will be :

- (1) $\frac{\ell\sigma}{\pi aY}$
- (2) $\frac{\pi aY}{\ell\sigma}$
- (3) $\frac{\ell\sigma}{aY}$
- (4) None

14) Four sources produce the following four waves

- (i) $y_1 = a \sin(2\omega t - kx + \phi_1)$
- (ii) $y_2 = a \sin(\omega t - kx)$
- (iii) $y_3 = a' \sin(\omega t - kx + \phi_2)$
- (iv) $y_4 = a' \sin(3\omega t - kx + \phi_3)$

The two expressions which on superposition give rise to stable interference detection

- (1) (i) and (ii)
- (2) (ii) and (iii)
- (3) (i) and (iii)
- (4) (iii) and (iv)

15) Two rods of equal length and diameter but of thermal conductivities 2 unit and 3 unit respectively are joined in parallel. The thermal conductivity of a rod of geometrical dimension equal to either of the rod, which can conduct the same heat is :-

- (1) 1 unit
- (2) 1.5 unit
- (3) 2.5 unit
- (4) 5 unit

16) The ratio of translation and rotational kinetic energies at 200 K is 3 : 2. Then find the internal energy of one mole of same gas at that temperature. ($R = 8.3 \text{ J/mol}\cdot\text{K}$) :-

- (1) 2350 J
- (2) 2075 J
- (3) 4150 J
- (4) 8300 J

17) A particle moves in circular path with uniform speed. Its motion is :

- (1) Periodic
- (2) Oscillatory
- (3) Simple harmonic
- (4) Angular SHM

18) A body executes simple harmonic motion under the action of a force F_1 with a time period $(4/5)$ sec. If the force is changed to F_2 it executes SHM with time period $(3/5)$ sec. If both the forces F_1 and F_2 act simultaneously in the same direction on the body, its time period (in second) is :

- (1) $12/25$
- (2) $24/25$
- (3) $35/24$
- (4) $25/12$

19) A rope diameter 2cm breaks if tension in it exceeds 500 N. The maximum tension that may be given to similar rope of diameter 4cm is :

- (1) 500 N
- (2) 250 N
- (3) 1000 N
- (4) 2000 N

20) A particle is projected from the mid - point of the line joining two fixed particles each of mass 'm'. If the separation between fixed particles is 'l', the minimum velocity of projection of the particle so as to escape is equal to

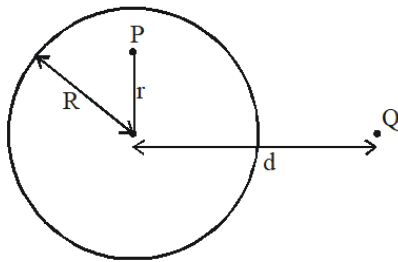
- (1) $\sqrt{\frac{Gm}{\ell}}$
- (2) $\sqrt{\frac{Gm}{2\ell}}$
- (3) $\sqrt{\frac{2Gm}{\ell}}$
- (4) $2\sqrt{\frac{2Gm}{\ell}}$

21) Rank the vernier callipers/screw gauge in the order of their increasing precision :

- (1) Screw gauge having main scale division 1mm and no. of circular division = 200.
- (2) Screw gauge having main scale division 0.5 mm and no. of circular division = 400.
- (3) Vernier callipers having main scale division = 1mm such that 9 MSD = 10 VSD.
- (4) Vernier callipers having main scale division = 1mm such that 4 MSD = 5 VSD.

- (1) $4 < 2 < 3 < 1$
- (2) $2 < 4 < 1 < 3$
- (3) $4 < 3 < 2 < 1$
- (4) $4 < 3 < 1 < 2$

22) An uncharged spherical conductor having radius R is as shown. Find potential at a point P:-



- (1) $\frac{kQ}{d}$
- (2) $\frac{kQ}{r}$
- (3) $\frac{kQ}{R}$
- (4) $\frac{kQ}{\sqrt{r^2 + d^2}}$

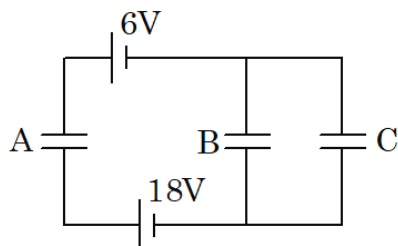
23) A copper wire carries a current of 10 A. It has cross-sectional area of 0.05 cm^2 . Density of copper is 8.9 g/cm^3 . Molar mass of copper is $63.5 \times 10^{-3} \text{ kg/mol}$. The drift speed of the electrons is closest to

- (1) $1.5 \times 10^{-4} \text{ m/s}$
- (2) $1.5 \times 10^4 \text{ m/s}$
- (3) $3.5 \times 10^{-4} \text{ m/s}$
- (4) 1.5 m/s

24) The length of the potentiometer wire is l . A cell of emf ε is balanced at length $l/3$ from the positive end of the wire. If the length of the wire is increased by $l/2$ at what distance will the same cell gives a balance point. [Neglect all the resistance, except potentiometer wire in primary circuit]

- (1) $\frac{\ell}{3}$
- (2) $\frac{\ell}{2}$
- (3) $\frac{2\ell}{3}$
- (4) $\frac{3\ell}{4}$

25) Three capacitors A, B and C each of capacitance $1\mu\text{F}$ are connected in a circuit as shown in figure. The energy stored in the capacitor C is



- (1) $4 \mu\text{J}$
- (2) $6 \mu\text{J}$

(3) $8 \mu\text{J}$

(4) $2 \mu\text{J}$

26) The magnetic field B_0 due to current carrying circular loop of radius 12 cm at its centre is $0.50 \times 10^{-4} \text{ T}$. The magnetic field due to this loop at a point on the axis at a distance of 5 cm from the centre is -

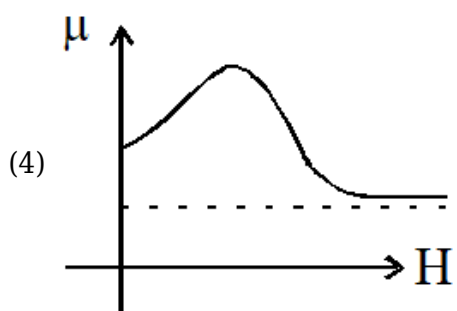
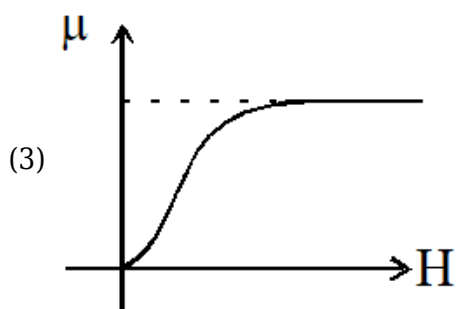
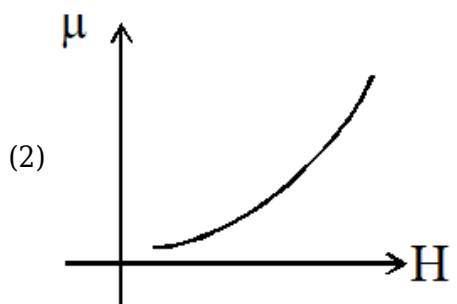
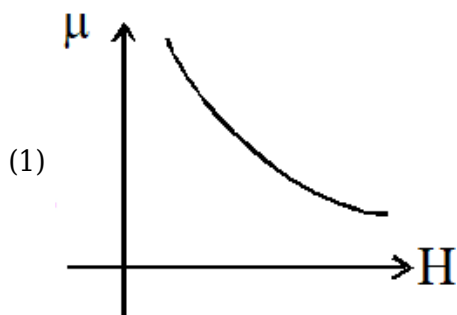
(1) $3.5 \times 10^{-9} \text{ T}$

(2) $5.3 \times 10^{-9} \text{ T}$

(3) $1.3 \times 10^{-5} \text{ T}$

(4) $3.9 \times 10^{-5} \text{ T}$

27) Choose correct variation of μ (permeability of material) with magnetising field intensity ($\vec{H}$) for a ferromagnetic material.



28) A bar magnet is released from rest along the axis of very long, vertical copper tube. After some time, the magnet :

- (1) will stop
- (2) will move with constant speed
- (3) will move with acceleration g
- (4) will oscillate

29) In L-R circuit, the inductive reactance is equal to the resistance of the circuit. An emf $V = V_0 \sin\left(\omega t - \frac{\pi}{3}\right)$ is applied to the circuit. The power consumption in the circuit is :

- (1) $\frac{V_0^2}{R}$
- (2) $\frac{V_0^2}{\sqrt{2}R}$
- (3) $\frac{V_0^2}{2R}$
- (4) $\frac{V_0^2}{4R}$

30) A small mirror of mass m is suspended by a light thread of length l . The angle through which the thread will be deflected when a short pulse of laser of energy E falls normally on the mirror is :-
(Assume mirror is a perfect reflector)

- (1) $\frac{2E}{mc\sqrt{2g\ell}}$
- (2) $\frac{mc\sqrt{g\ell}}{2E}$
- (3) $\frac{mc\sqrt{2g\ell}}{2E}$
- (4) $\frac{2E}{mc\sqrt{g\ell}}$

PART-II : CHEMISTRY

1) Four set of values of quantum numbers (n , l , m and s) are given below. Which of these does not provide a permissible solution of wave equation ?

- (1) 3, 2, -2, -1/2
- (2) 3, 3, 1, +1/2
- (3) 4, 2, 1, +1/2
- (4) 2, 1, 1, -1/2

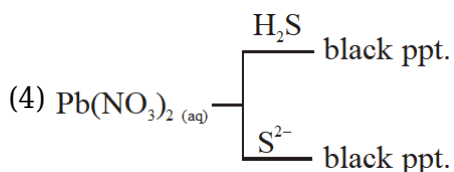
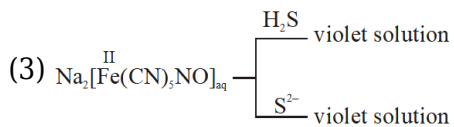
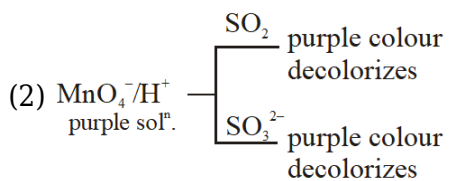
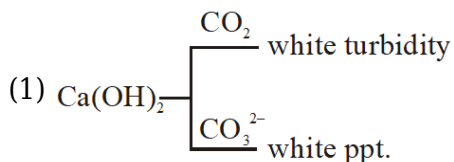
2) Identify the only incorrect statement

- (1) Fe^{3+} has greater electron affinity than Fe^{2+}
- (2) Between F and Cl, formation of Cl^- is more exothermic than formation of F^-
- (3) IE_1 of Cl^- = electron affinity of Cl
- (4) Electronegativity depends only electron affinity

3) Which of the following reaction is incorrect ?

- (1) $\text{SO}_2\text{Cl}_2 + \text{P}_4(\text{white}) \rightarrow \text{PCl}_5 + \text{SO}_2$
- (2) $\text{I}^- + \text{H}^+ + \text{KMnO}_4 \rightarrow \text{IO}_3^- + \text{Mn}^{2+}$
- (3) $\text{I}_2\text{O}_5 + \text{CO} \rightarrow \text{CO}_2 + \text{I}_2$
- (4) $\text{XeF}_6 \xrightarrow[\text{in alkaline medium}]{\text{hydrolysis}} \text{HXeO}_4^- \xrightarrow{\text{OH}^-} \text{XeO}_6^{4-} + \text{Xe} + \text{O}_2$

4) Select incorrect option.



5) The co-ordination number and oxidation number of X in the compound $[\text{X}(\text{SO}_4)(\text{NH}_3)_5]$ will be -

- (1) 10 and +3
- (2) 1 and +6
- (3) 6 and +4
- (4) 6 and +2

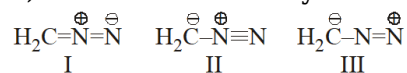
6) Select the correct option :

- (1) $\text{Ce}^{+4} < \text{Ce}^{+3}$ (stability in aq. solution)
- (2) $\text{Pm}^{+3} < \text{Yb}^{+3}$ (ionic radii)
- (3) $\text{Gd}^{+3} < \text{Lu}^{+3}$ (paramagnetic)
- (4) All of these

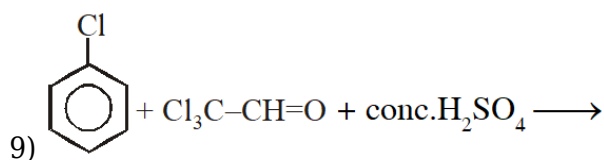
7) Which one is not the correct statement ? Pollutions means :

- (1) The presence of anything in the environment in excess of the required limit
- (2) Anything put into the environment which was not there in its natural state.
- (3) Direct or indirect changes in one or more components of the ecosystem which are not harmful to living organisms
- (4) International release of any chemical substance in the environment with harmful effects

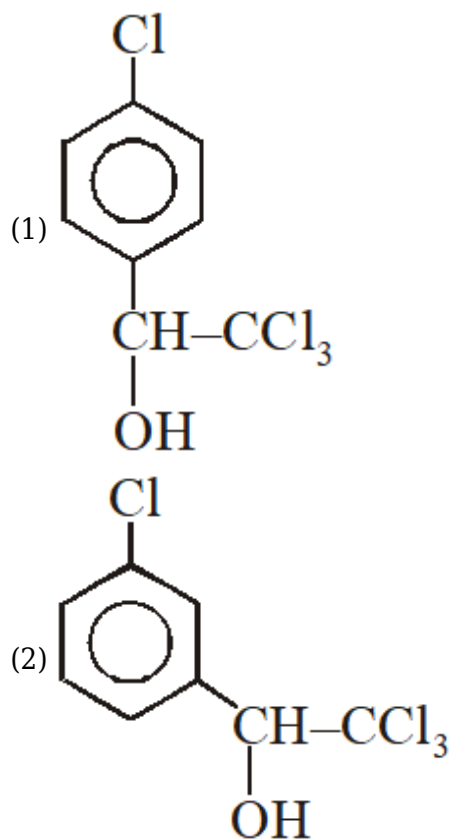
8) The correct stability order of the following resonating structure is :

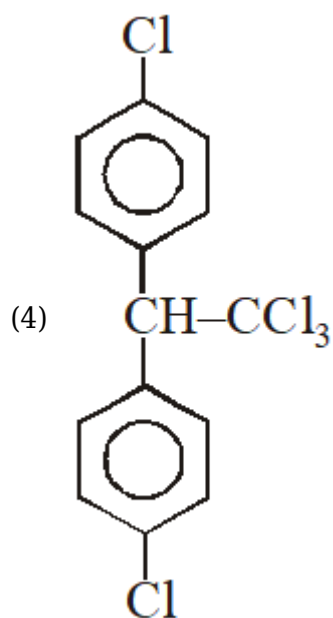
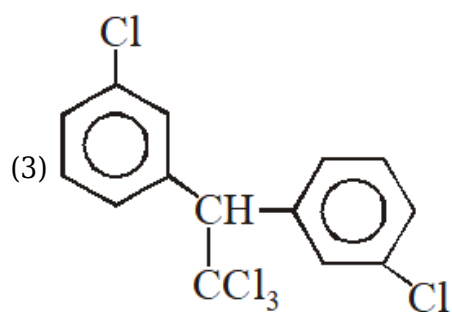


- (1) III > II > I
- (2) II > I > III
- (3) I > II > III
- (4) III > I > II

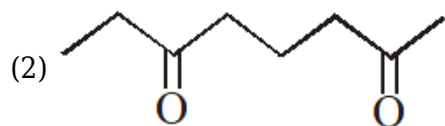
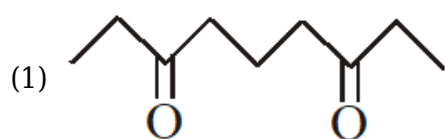
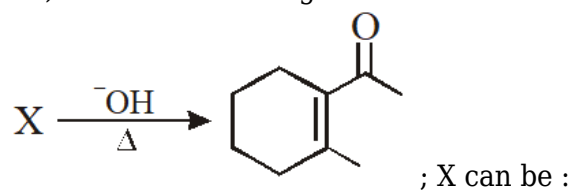


Product (P). P is :

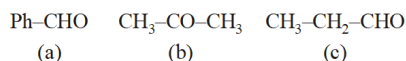




10) Consider following intramolecular aldol condensation reaction :



11) Which of the following pair can not distinguish by given test ?



- (1) (a) & (b) $\rightarrow$ Tollen's test
- (2) (b) & (c) $\rightarrow$ Haloform test
- (3) (a) & (c) $\rightarrow$ Fehling test
- (4) (b) & (c) $\rightarrow$ Aq. NaHSO_3

12) Secondary structure of protein refers to :

- (1) Three-dimensional structure, specially the bond between amino acid residues that are distant from each other in the polypeptide chain
- (2) Regular folding patterns of the polypeptide chain
- (3) Mainly denatured proteins and structures of prosthetic groups
- (4) Linear sequence of amino acid residues in the polypeptide chain

13) Incorrect statement regarding natural rubber

- (1) It is a homopolymer
- (2) It is formed by 1, 4 addition of 2-methyl buta 1,3-diene
- (3) It is soluble in water
- (4) It is a cis-isomer

14) Alkyl halides react with dialkyl copper reagent to give

- (1) alkyl copper halides
- (2) alkenes
- (3) alkenyl halides
- (4) alkanes

15) The more stable conformer of ethylene glycol in water is :

- (1) Anti form
- (2) Gauche form
- (3) Fully eclipsed form
- (4) Partially eclipsed form

16) The most basic compound among the following is :-

- (1) Acetanilide
- (2) Benzylamine
- (3) p-Nitro aniline
- (4) Aniline

17) Which of the following indicates open chain structure of glucose ?

- (1) Penta-acetyl derivative of glucose

- (2) Cyanohydrin formation with HCN
- (3) Reaction with Fehling solution
- (4) Reaction with Tollen's reagent

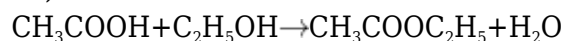
18) Among the following, the surfactant that will form micelles in aqueous solution at the highest molar concentration at ambient conditions is

- (1) $\text{CH}_3(\text{CH}_2)_{15}\text{N}^+(\text{CH}_3)_3\text{Br}^-$
- (2) $\text{CH}_3(\text{CH}_2)_{11}\text{OSO}_3^-\text{Na}^+$
- (3) $\text{CH}_3(\text{CH}_2)_6\text{COO}^-\text{Na}^+$
- (4) $\text{CH}_3(\text{CH}_2)_{11}\text{N}^+(\text{CH}_3)_3\text{Br}^-$

19) Boyle's law may be expressed as

- (1) $\left(\frac{dP}{dV}\right)_r = \frac{K}{V}$
- (2) $\left(\frac{dP}{dV}\right)_r = -\frac{K}{V^2}$
- (3) $\left(\frac{dP}{dV}\right)_r = \frac{K}{V}$
- (4) $\left(\frac{dP}{dV}\right)_r = \frac{K}{V^2}$

20) One dm^3 of 2 M ethanoic acid is mixed with one dm^3 of 3 M ethanol to form an ester.



The decrease in the initial rate if each solution is diluted with an equal volume of water would be

- (1) 0.25 times
- (2) 0.5 times
- (3) 2 times
- (4) 4 times

21) An element X crystallises in a bcc structure. Calculate the radius of the X atom if the edge length of the unit cell is 400 pm

- (1) 17.32 pm
- (2) 173.2 pm
- (3) 346.6 pm
- (4) 34.66 pm

22) The dissociation of CO_2 can be expressed as $2\text{CO}_2(\text{g}) \rightleftharpoons 2\text{CO}(\text{g}) + \text{O}_2(\text{g})$. If the 2 moles of CO_2 is taken initially and 40% of the CO_2 is dissociated completely. What is the total number of moles at equilibrium:-

- (1) 2.4
- (2) 2.0

(3) 1.2

(4) 5

23) When a gas is compressed adiabatically and reversibly, the final temperature is-

(1) Higher than the initial temperature

(2) Lower than the initial temperature

(3) The same as initial temperature

(4) Dependent upon the rate of compression

24) What should the H^+ concentration be in solution that is 0.25 M in Co^{2+} to prevent the precipitation of CoS when the solution is saturated with H_2S . A saturated solution of H_2S is 0.1 M :
 $K_{sp}(CoS) = 5 \times 10^{-22}$, $K_1(H_2S) = 1.1 \times 10^{-8}$, $K_2(H_2S) = 1 \times 10^{-13}$

(1) 0.523

(2) 0.234

(3) 0.725

(4) 0.924

25) 60g of urea is dissolved and 1100g solution is made. To keep $\Delta T_f/K_f$ as 1 mol/kg, water separated in the form of ice is

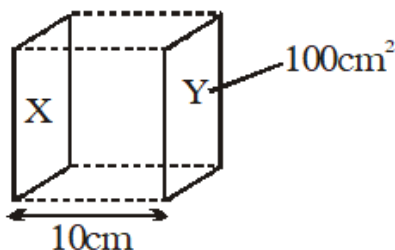
(1) 60

(2) 20

(3) 0

(4) 40

26) The conductance of a salt solution (AB) measured by two parallel electrode of area 100 cm^2 separated by 10 cm was found to be $0.0001 \Omega^{-1}$. If volume enclosed between two electrode contain 0.5 mole of salt, what is the molar conductivity ($\text{Scm}^2 \text{ mol}^{-1}$) of salt at same conc -



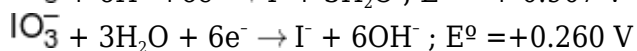
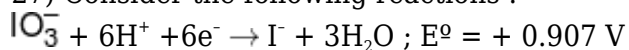
(1) 0.01

(2) 0.02

(3) 2×10^{-5}

(4) 0.002

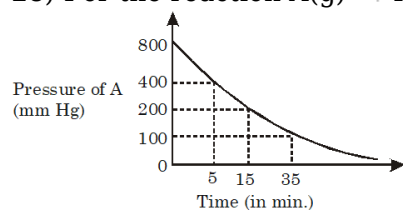
27) Consider the following reactions :



Predict where does IO_3^- acts as a better oxidant?

- (1) In acidic medium
- (2) In basic medium
- (3) In pure water
- (4) Equally effective in both acidic and basic mediums

28) For the reaction $\text{A(g)} \rightarrow \text{P(g)}$



Order of reaction should be

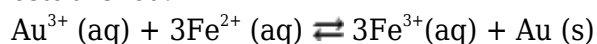
- (1) 0
- (2) 1
- (3) 2
- (4) 3

29) For the reaction : $x\text{A} \rightarrow y\text{B}$,
 $\log_{10} \left(-\frac{d[\text{A}]}{dt} \right) = \log_{10} \left(+\frac{d[\text{B}]}{dt} \right) + 0.3$

If the value of $\log_{10} 5 = 0.7$, the value of x : y is:

- (1) 2 : 1
- (2) 1 : 2
- (3) 3 : 10
- (4) 5 : 2

30) Starting with 250 ml of Au^{3+} solution and 250 ml of Fe^{2+} solution, the following equilibrium is established.



At equilibrium, the equivalents of Au^{3+} , Fe^{2+} , Fe^{3+} and Au are x, y, z and w respectively. Then

- (1) $K_C = \frac{z^3}{6xy^3}$
- (2) $K_C = \frac{3z^3}{2xy^3}$
- (3) $K_C = \frac{4z^3}{9xy^3}$
- (4) $K_C = \frac{8z^3}{9xy^3}$

1) If $z_1 = 3 - 5i$ and $z_2 = -3 - 5i$ then $\arg\left(\frac{z_1}{z_2}\right)$ is equal to :-

(1) $\pi - 2\tan^{-1}\left(\frac{5}{3}\right)$

(2) $\frac{\pi}{2}$

(3) π

(4) $-2\tan^{-1}\left(\frac{5}{3}\right)$

2) $\frac{\int_0^3 [x] dx}{\int_0^3 \{x\} dx}$ (where $[.]$ greatest integer function & $\{.\}$ fractional part function) is equal to :-

(1) 1

(2) $3/2$

(3) 3

(4) 2

3) If $a = \frac{1+i}{\sqrt{2}}$ then value of $a^6 + a^4 + a^2 + 1$ is:

(1) 0

(2) 1

(3) i

(4) -i

4) If α, β, γ are the roots of the equation $x^3 - 2x^2 + 50x + 1 = 0$, then the value of $\left(\alpha - \frac{1}{\beta\gamma}\right)\left(\beta - \frac{1}{\gamma\alpha}\right)\left(\gamma - \frac{1}{\alpha\beta}\right) =$

(1) 1

(2) -8

(3) 0

(4) -1

5) $\int (\sec 2x + 1)\sqrt{\sec^2 x - 1} dx$ is equal to -

(1) $\frac{\ln \sec x}{2} + c$

(2) $\frac{\ln \sec 2x}{2} + c$

(3) $\ln \sec 2x + c$

(4) $\ln \sec x + c$

6) The equation $x^4 + x^2 + 2x + 1 = 0$ has :-

- (1) exactly 4 real solutions
- (2) exactly 2 real solutions
- (3) no real solution
- (4) exactly three real solutions

7) $\int \frac{\sec x \cdot \operatorname{cosec} x}{2 \cot x - \sec x \operatorname{cosec} x} dx$

- (1) $\frac{1}{2} \ln |\sec 2x + \tan 2x| + c$
- (2) $\ln |\sec x + \operatorname{cosec} x| + c$
- (3) $\ln |\sec x + \tan x| + c$
- (4) $\frac{1}{2} \ln |\sec x + \operatorname{cosec} x| + c$

8) If sum of 4th, 7th & 10th term of an A.P. is 15, then sum of first thirteen terms of same A.P., is -

- (1) 10
- (2) 25
- (3) 65
- (4) 85

9) The maximum sum of the series $20 + 19\frac{1}{3} + 18\frac{2}{3} + 18 + \dots$ is -

- (1) 310
- (2) 290
- (3) 320
- (4) None

10) If $\vec{r} = x\hat{i} + y\hat{j} + 3\hat{k}$ and $\vec{a} = 4y\hat{i} - x\hat{j} - \hat{k}$, $x, y \in I$ such that $\vec{r} \cdot \vec{a} = 27$, then number of possible ordered pairs of (x, y) are-

- (1) 4
- (2) 2
- (3) 6
- (4) 8

11) The sum of all integers between 81 and 719 which are divisible by 5 is -

- (1) 51800
- (2) 50800
- (3) 52800

(4) none of these

12) I alternatively toss a fair coin and throw a fair die untill I, either toss a head or throw a 2. If I toss the coin first, the probability that I throw a 2 before I toss a head, is -

(1) $\frac{1}{7}$

(2) $\frac{7}{12}$

(3) $\frac{5}{12}$

(4) $\frac{5}{7}$

13) If A & B are independent events, then $\bar{A}$ and B-

(1) are dependent

(2) are mutually exclusive

(3) may be independent

(4) are independent

14) Number of ordered triplets (a, b, c) of positive integers less than 10, for which the product 'abc' is divisible by 20 is -

(1) 54

(2) 96

(3) 100

(4) 102

15) Suppose f and g both are linear function with $f(x) = -2x + 1$ and $f(g(x)) = 6x - 7$, then slope of line $y = g(x)$ is -

(1) 3

(2) -3

(3) 6

(4) -2

16) Let $f(x) = x^3 + ax + b$ with $a \neq b$ and suppose the tangent lines to the graph of f at $x = a$ and $x = b$ have the same gradient. Then the value of $f(1)$ is equal to -

(1) 0

(2) 1

(3) $-\frac{1}{3}$

(4) $\frac{2}{3}$

17) If $x + y = t - \frac{1}{t}$, $x^2 + y^2 = t^2 + \frac{1}{t^2}$, then $\frac{dy}{dx}$ is equal to -

- (1) $1/x$
- (2) $-1/x$
- (3) $1/x^2$
- (4) $-1/x^2$

18) If $f(x) = 2\ln x - x$ is increasing, then x can lie in-

- (1) (1, 3)
- (2) (2, 3)
- (3) (3, 4)
- (4) (5, 6)

19) Rolle's theorem in the indicated intervals will not be valid for which of the following function

$$(1) f(x) = \begin{cases} \frac{\sin x}{x} & x \neq 0 \\ 1 & x = 0 \end{cases} ; x \in [-1, 1]$$

$$(2) g(x) = \begin{cases} \frac{1 - \cos x}{x} & x \neq 0 \\ 0 & x = 0 \end{cases} ; x \in [-2\pi, 2\pi]$$

$$(3) h(x) = \begin{cases} \frac{1 - \cos x}{x^2} & x \neq 0 \\ \frac{1}{2} & x = 0 \end{cases} ; x \in [-2\pi, 2\pi]$$

$$(4) k(x) = \begin{cases} x \sin\left(\frac{1}{x}\right) & x \neq 0 \\ 0 & x = 0 \end{cases} ; x \in \left[-\frac{1}{\pi}, \frac{1}{2\pi}\right]$$

20) Let $f(x) = \cos x - 1 + \frac{x^2}{2}$, then :-

- (1) $f(x)$ is an increasing function on the real line
- (2) $f(x)$ is an decreasing function on the real line
- (3) $f(x)$ is an increasing function in $(-\infty, 0)$ and decreasing in $(0, \infty)$
- (4) $f(x)$ is an decreasing function in $(-\infty, 0)$ and increasing in $(0, \infty)$

21) If $2x^2 + (\lambda - 3)y^2 + (\mu + 3)xy + 8ax + 12(1 - a)y - 42 = 0$ is the equation of circle whose radius cannot exceed 5, then integral value of $\lambda + \mu + a$ is -

- (1) 9
- (2) 2
- (3) 3
- (4) not possible

22) $\sum_{r=1}^n {}^r C_0 + \sum_{r=1}^n {}^r C_1 + \sum_{r=2}^n {}^r C_2 + \dots + \sum_{r=n-1}^n {}^r C_{n-1} + {}^n C_n$ is equal to -

- (1) $2^{n+1} - 1$
- (2) $2^{n+1} - 2$
- (3) $2^n - 2$
- (4) $(2^n + 1)$

23) Sum of areas of two circles touching externally and whose centres are 15 cms apart is $153\pi(\text{cm})^2$. The ratio of radius of bigger circle to smaller circle is :-

- (1) 3 : 2
- (2) 4 : 1
- (3) 3 : 1
- (4) 4 : 3

24) The coefficient of x^9 in the expansion of $(x - 1)(x - 2)(x - 3) \dots (x - 10)$ -

- (1) -100
- (2) 100
- (3) -110
- (4) -55

25) Normal form of line $x + \sqrt{3}y - 4 = 0$ is -

- (1) $x \cos \pi/3 - y \sin \pi/3 = 2$
- (2) $x \cos \pi/6 - y \sin \pi/6 = 2$
- (3) $x \cos \pi/3 + y \sin \pi/3 = 2$
- (4) $x \cos \pi/6 + y \sin \pi/3 = 2$

26) Number of rational terms in $(\sqrt[4]{5} + \sqrt[3]{2})^{100}$ is -

- (1) 2
- (2) 3
- (3) 4
- (4) 5

27) Equation of chord of a circle $S : (x - 3)^2 + (y - 4)^2 = 25$, which passes through two points on the circle situated at a distance 3 units from origin, is -

- (1) $2x + 3y - 3\sqrt{13} = 0$
- (2) $6x + 8y = 9$
- (3) $2x - 3y + 3\sqrt{13} = 0$
- (4) $6x - 8y + 9 = 0$

28) If the matrices A, B, (A + B) are non singular, then $[A(A + B)^{-1}B]^{-1}$ is equal to -

- (1) A + B
- (2) $A^{-1} + B^{-1}$
- (3) $(A + B)^{-1}$
- (4) $B^{-1}A + BA^{-1}$

29) Let $\lambda x - y - 4 = 0$ any chord of circle $x^2 + y^2 = 4$ meeting it at A and B and the tangents drawn to the circle at A, B meet at C. The locus of circumcentre of triangle ABC is-

- (1) $x = -1$
- (2) $y = -1$
- (3) $y = -\frac{1}{2}$
- (4) $x = -\frac{1}{2}$

30) A, B, C are square matrices of same order such that $AB = I$, then the number of matrix P such that $APB = I$ is/are -

- (1) 0
- (2) 1
- (3) 2
- (4) infinite

31) Number of solution of the equation $\sin^2 x - \tan^2 x = 1$ is/are -

- (1) 0
- (2) 1
- (3) 2
- (4) 3

32) Let $A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$ and $10B = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix}$. If B is the inverse of matrix A, then α is -

- (1) -2
- (2) -1
- (3) 2
- (4) 5

33) The value of $(1 + \sin \alpha \sin \beta)^2 - (\sin \alpha + \sin \beta)^2$ is equal to -

- (1) $\cos^2 \alpha + \cos^2 \beta$
- (2) $\cos^2 \alpha - \cos^2 \beta$

(3) $\cos^2 \alpha \cos^2 \beta$

(4) $\sin^2 \alpha \sin^2 \beta$

34) $\cos \left(\frac{\pi}{4} + \frac{1}{2} \cos^{-1} \left(\frac{a}{b} \right) \right) + \cos \left(\frac{\pi}{4} - \frac{1}{2} \cos^{-1} \left(\frac{a}{b} \right) \right)$ is equal to -

(1) $\pm \sqrt{\frac{a+b}{a}}$

(2) $\pm \sqrt{\frac{b}{a+b}}$

(3) $\sqrt{\frac{a+b}{b}}$

(4) none of these

35) The equation $5^{1+\log_5 \cos x} = \frac{5}{2}$ has -

(1) no solution

(2) one solution

(3) two solutions

(4) more than two solutions

36) If $\sin^{-1} x = \sqrt{\cos^{-1} x} + \frac{\pi}{2}$, then x is equal to -

(1) 0

(2) -1

(3) 1

(4) 1/2

37) The number of solutions of the equation

$6\cos^5 \theta - 6\cos^4 \theta - 5\cos^3 \theta + 5\cos^2 \theta + \cos \theta - 1 = 0$, where $0 < \theta < 360^\circ$ is -

(1) 2

(2) 4

(3) 6

(4) 8

38) Range of $\sin^{-1} x + \operatorname{cosec}^{-1} x$ is -

(1) $\{-\pi, \pi\}$

(2) $(-\pi, \pi)$

(3) $\left\{0, \frac{\pi}{2}\right\}$

(4) None of these

39) If $\sin^{-1}(x^2) = \cos^{-1} x$, then $x^4 + x^2$ is :-

- (1) $\frac{1}{4}$
- (2) 1
- (3) $\frac{1}{2}$
- (4) $\frac{2}{5}$

40) If $x = \frac{1 + \sqrt{3}i}{2}$ then the value of the expression, $y = x^4 - x^2 + 6x - 4$, equals -

- (1) $-1 + 2\sqrt{3}i$
- (2) $2 - 2\sqrt{3}i$
- (3) $2 + 2\sqrt{3}i$
- (4) none

PART-IV(A) : English Proficiency

Common Content for Question No. 1 to 2

Choose the opposite of the given words.

1) GALE

- (1) Yell
- (2) Calm
- (3) Peal
- (4) Scream

2) ANARCHY

- (1) Cheery
- (2) Peafowl
- (3) Jab
- (4) Government

Common Content for Question No. 3 to 4

In the following sentences, a word is in bold letters, find out the error of time or verb in the same and replace it with the most suitable alternative.

3) Did you ever bothered about your marks?

- (1) Had
- (2) Has
- (3) Have
- (4) Was

4) The students marked the answers before the teacher collected the sheets.

- (1) Had marked
- (2) Has marked
- (3) Have marked
- (4) Mark

Common Content for Question No. 5 to 6

In the following, pick the odd word out:

5) Mark the odd one out

- (1) Wily
- (2) Canny
- (3) Shrewd
- (4) Outspoken

6) Mark the odd one out

- (1) Ceaseless
- (2) Continual
- (3) Non-stop
- (4) Transitory

Common Content for Question No. 7 to 8

Read the below given sentences and choose the option which will be the correct question tag for it:

7) Let's go for a walk, _____?

- (1) Are we
- (2) Will we
- (3) Shall we
- (4) should we

8) I am running out of time, _____?

- (1) Am I
- (2) isn't I
- (3) Aren't I
- (4) Are I

Common Content for Question No. 9 to 10

Read the below given sentences and choose the part of the sentence that has adjective error. In case of no error, mark 'D' as the answer.

9) Darian held his 20-pounds dumbbell to do squats at the gym, but to his surprise his younger brother's dumbbells weight 25 pounds.

- (1) To his surprise his younger brother's
- (2) Darian held his 20-pounds dumbbell
- (3) Dumbbell weight 25 pounds
- (4) No change

10) Of Sofia, Luna, and Nora, the latter joined ballet class in order to learn discipline, patience, and teamwork.

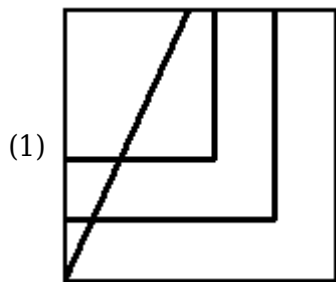
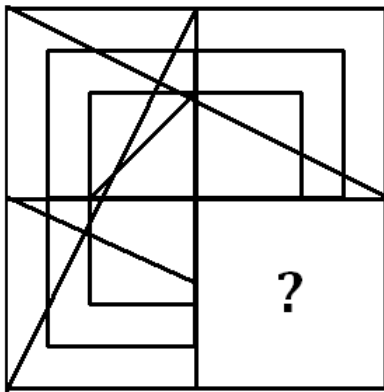
- (1) Ballet class in order to learn
- (2) Of Sofia, Luna, and Nora, the latter joined
- (3) Discipline, patience and teamwork
- (4) No change

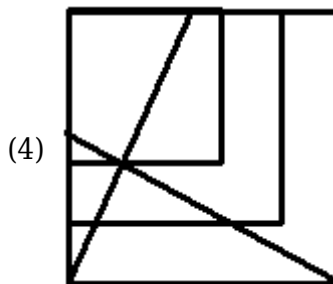
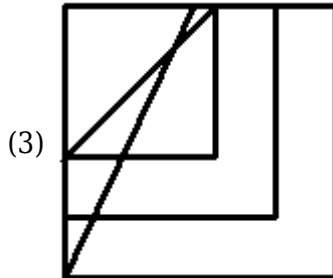
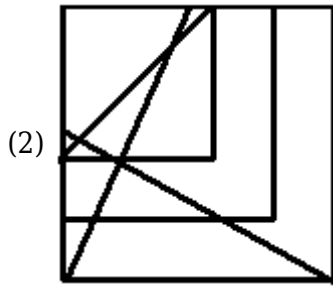
PART-IV(B) : Logical Reasoning

1) Select the correct word from the given options to replace the question mark in the given analogy.
Crows : Caw :: Dolphins : ?

- (1) Quack
- (2) Cluck
- (3) Click
- (4) Creak

2) Identify the figure to complete the given pattern.





3) Select the correct option to replace the question mark in the given series.

1, 1, 6, 5, 16, 14, 36, 30, 76, 55, ?

(1) 154

(2) 155

(3) 156

(4) 157

4) Choose the word which is different from the rest in the given group.

Nile, Snake, Orange, Yellow, Grey, Green

(1) Snake

(2) Orange

(3) Nile

(4) Grey

5) Identify the figure which is made by rearranging the parts of the figure X.

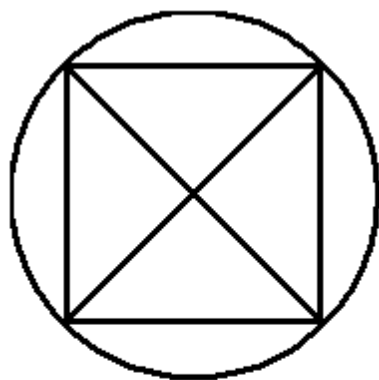
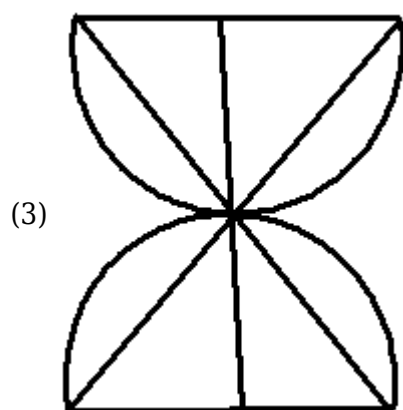
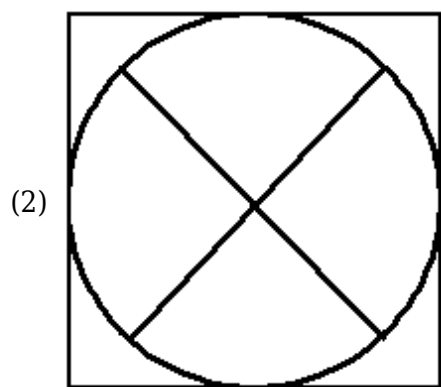
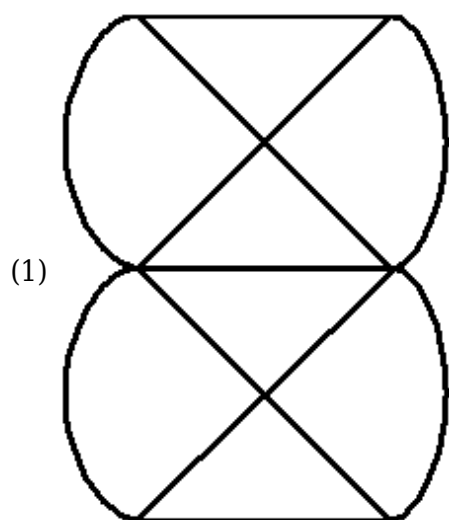
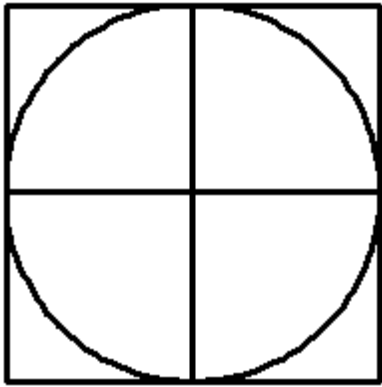


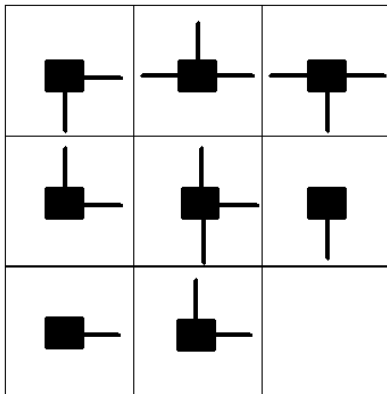
Fig. X



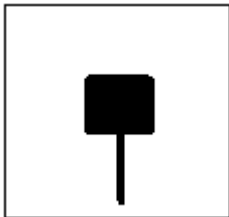
(4)



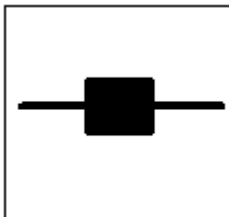
6) Identify the figure that completes the figure matrix.



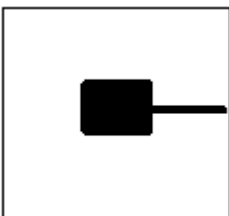
(1)



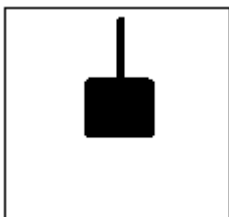
(2)



(3)



(4)



7) Select the correct option to replace the question mark in the given figure.

T	B	P	L
M	32	34	F
O	?	38	H
I	A	S	K

- (1) 36
- (2) 40
- (3) 25
- (4) 24

8) How many letters are there in the English alphabetical series between the third letter of the fourth word from the right and second letter of the second word from the left?

BAG, ASH, WAY, MAD, LAB, BID

- (1) 18
- (2) 5
- (3) 14
- (4) 23

9) Choose the word which is different from the rest in the given group.

Plate, Bowl, Cup, Spoon, Saucer

- (1) Plate
- (2) Bowl
- (3) Spoon
- (4) Saucer

10) Identify the figure that most closely resembles the unfolded form of the figure Z.

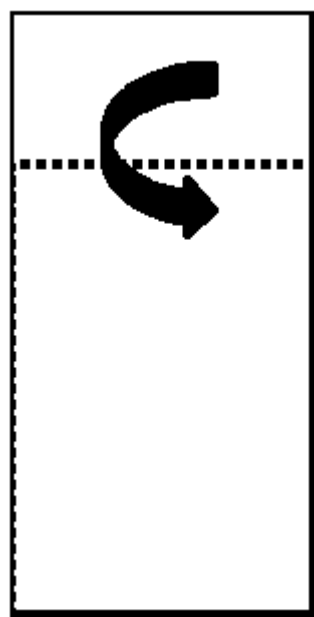


Fig. W

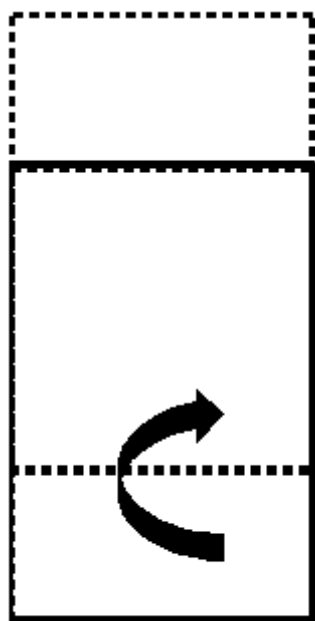


Fig. X

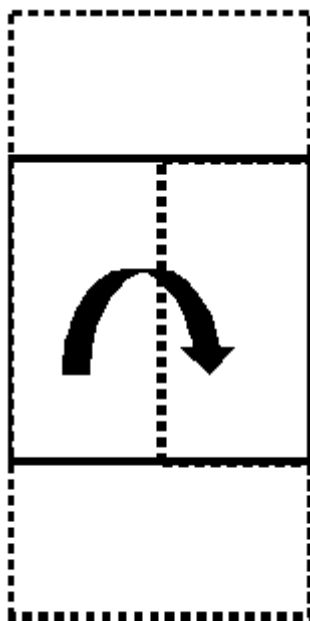


Fig. Y

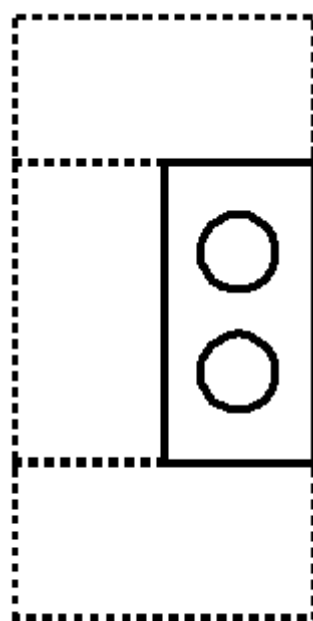
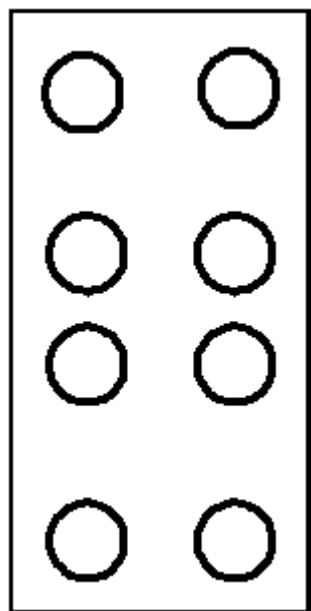
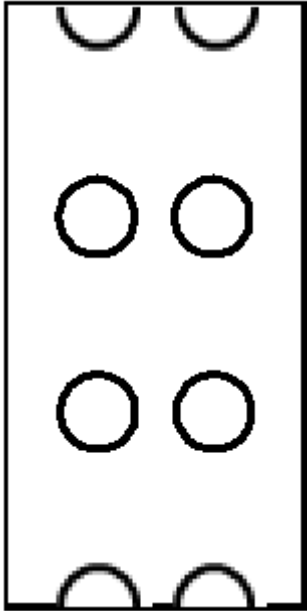


Fig. Z

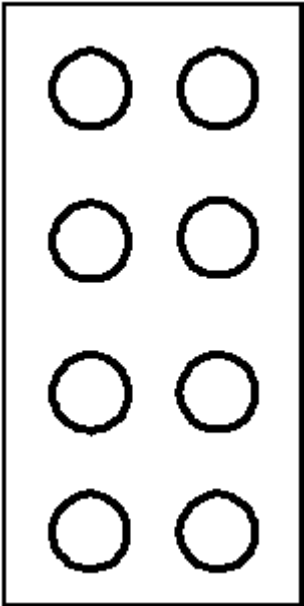
(1)



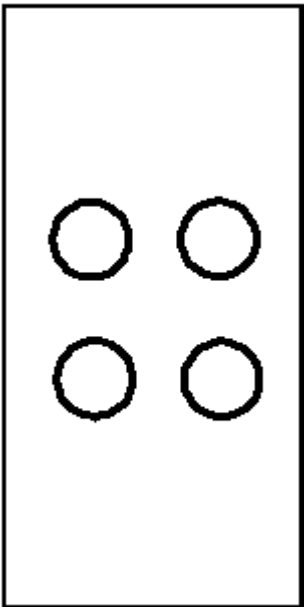
(2)



(3)



(4)



In the following question complete the given number series with the most suitable alternative in place of question mark (?)

11) 0, 6, 24, 60, 120, 210, ?

- (1) 240
- (2) 290
- (3) 336
- (4) 504

Common Content for Question No. 12 to 13

In the following question complete the given number series with the most suitable alternative in place of question mark (?)

12) 1, 3, 3, 6, 7, 9, ?, 12, 21

- (1) 10
- (2) 11
- (3) 12
- (4) 13

13) **Direction:** In substitution coding some particular objects are assigned as code names and the question is asked that is to be answered in the code language.

If 'Cook' is called 'Butler', 'Butler' is called 'Manager', 'Manager' is called 'Teacher', 'Teacher' is called 'Clerk' and 'Clerk' is called 'Principal', who will teach in a class ?

- (1) Cook
- (2) Butler
- (3) Clerk
- (4) Teacher

14) **Direction:** In this type of questions, a round about description is given in the form of certain small relationships and direct relationship between the persons concerned is to be deciphered and choose correct answer.

Pointing to a man on the stage, Rita said, "He is the brother of the daughter of the wife of my husband".

How is the man on the stage related to Rita ?

- (1) Son
- (2) Husband
- (3) Cousin
- (4) Nephew

15) **Direction:** In this type of questions, a round about description is given in the form of certain small relationships and direct relationship between the persons concerned is to be deciphered and choose correct answer.

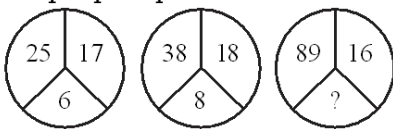
If $3 + 9 = 31$; $15 + 12 = 45$; $18 + 9 = 36$ then $12 + 27 = ?$

- (1) 49
- (2) 14
- (3) 94
- (4) 72

16) A man is facing north-west. He turns 90° in the clockwise direction and then in 135° the anticlockwise direction. Which direction is he facing now ?

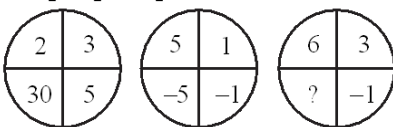
- (1) East
- (2) West
- (3) North
- (4) South

17) Direction : Number are placed in figure on the basis of some rules. One place is vacant which is indicated as (?). Find out the correct alternative for the vacant place and write its number against the proper question number on your answer sheet.



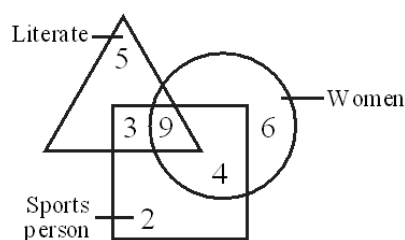
- (1) 13
- (2) 15
- (3) 17
- (4) 19

18) Direction : Number are placed in figure on the basis of some rules. One place is vacant which is indicated as (?). Find out the correct alternative for the vacant place and write its number against the proper question number on your answer sheet.



- (1) -9
- (2) -18
- (3) 18
- (4) 8

19) Direction : Based on the following figure. Triangle represents literate person, circle represents women and square represents sports persons. See the picture carefully and find out the correct alternative and write its number on your answer sheet



How many women are literate

- (1) 6
- (2) 4
- (3) 19
- (4) 9

20) How many times in a day the hands of a clock are straight pointing opposite each other

- (1) 20
- (2) 12
- (3) 24
- (4) 22

ANSWER KEYS

PART-I : PHYSICS

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A.	3	4	1	1	2	2	4	1	2	3	3	2	1	2	4	3	1	1	4	4
Q.	21	22	23	24	25	26	27	28	29	30										
A.	4	1	1	2	3	4	4	2	4	4										

PART-II : CHEMISTRY

Q.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A.	2	4	2	3	4	1	3	3	4	4	4	2	3	4	1	2	1	3	2	1
Q.	51	52	53	54	55	56	57	58	59	60										
A.	2	1	1	2	4	2	1	3	1	2										

PART-III : MATHEMATICS

Q.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
A.	1	4	1	2	2	3	1	3	1	4	2	1	4	4	2	2	3	1	4	4
Q.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
A.	3	2	2	4	3	3	2	2	3	2	1	4	3	3	4	3	4	1	2	1

PART-IV(A) : English Proficiency

Q.	101	102	103	104	105	106	107	108	109	110
A.	2	4	3	1	4	4	3	3	2	2

PART-IV(B) : Logical Reasoning

Q.	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
A.	3	2	3	4	3	1	3	2	3	1	3	4	3	1	3	2	2	2	4	4

SOLUTIONS

PART-I : PHYSICS

$$1) L \propto E^a F^b T^c$$

$$L = (ML^2T^{-2})^a (M^1L^1T^{-2})^b T^c$$

$$L = M^{a+b} L^{2a+b} T^{-2a-2b+c}$$

$$a + b = 0$$

$$2a + b = 1$$

$$-2a - 2b + c = 0$$

$$2a - a = 1$$

$$a = 1$$

$$b = -1$$

$$\therefore L = E^a F^b T^c = E^1 F^{-1} \text{ or length} = \text{energy/force}$$

$$(1 \text{ star meter}) = (1 \text{ star joule})^1 (1 \text{ star N})^{-1}$$

$$= (10^3)^1 (10^4)^{-1} [(\text{Joule})^1 (\text{N})^{-1}]$$

$$1 \text{ star meter} = 10^{-1} \text{ m}$$

$$\therefore 1 \text{ m} = 10 \text{ star meter}$$

$$2) \text{ Area } 1.5 \times 1.203 = 1.8045 \text{ cm}^2 = 1.8 \text{ cm}^2$$

(Upto correct number of significant figure).

$$3) \text{ Let } \vec{P} + \vec{Q} = \vec{a}$$

$$\vec{P} - \vec{Q} = \vec{b}$$

$$\text{Component of } \vec{a} \text{ along } \vec{b} = a \cos \theta \times \hat{b}$$

$$= \frac{\vec{a} \cdot \vec{b}}{b^2} \times \vec{b} \Rightarrow \frac{P^2 - Q^2}{P^2 + Q^2} (\vec{P} + \vec{Q})$$

$$4) 400 > 2a(100)$$

$$a < 2$$

$$5) 2V_E - V_C = 0$$

$$V_C = 2V_E$$

$$V_C \uparrow$$

$$\downarrow V_E$$

$$V_{CE} = V_C + V_E$$

$$V_{CE} = 3V_E$$

$$V_{CE} = 45 \text{ ft/s}$$

$$6) \vec{F} = 3\hat{i} + 5\hat{j}$$

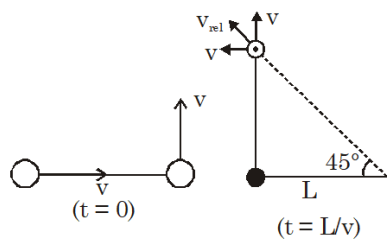
$$\vec{S} = 2t^2\hat{i} - 5\hat{j} \quad \frac{d\vec{S}}{dt} = 4t\hat{i}$$

$$\begin{aligned} \omega &= \int \vec{F} \cdot d\vec{s} = \int_0^2 (3t\hat{i} + 5\hat{j}) \cdot (4t\hat{i}) dt \\ &= \int_0^2 12t^2 dt \\ &= 4(2^3 - 0^2) = 32 \text{ J} \end{aligned}$$

8) tangential acceleration = $R\alpha$

centripetal acceleration = $2\sqrt{2}R\alpha$

$$a_{\text{net}} = \sqrt{(R\alpha)^2 + (2\sqrt{2}R\alpha)^2} = 3R\alpha$$



10)

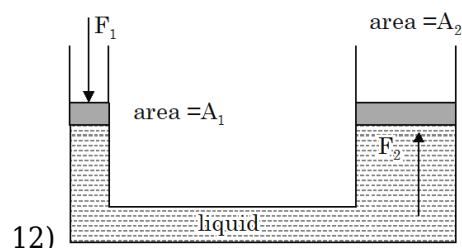
so in the direction of string $\Rightarrow mv = 2mv_1$

$$\Rightarrow v_1 = \frac{v}{2} \Rightarrow \begin{array}{c} \uparrow \frac{v}{2} \\ \frac{v}{2} \uparrow \\ \bullet \rightarrow v \end{array} \quad (t > L/v)$$

$\therefore$ KE of the system

$$\frac{1}{2}m\left(\frac{v}{2}\right)^2 + \frac{1}{2}m\left(\frac{v^2}{4} + v^2\right)$$

$$\begin{aligned} 11) d_A > d_B &\Rightarrow V_B > V_A \\ &\Rightarrow A_B > A_A \\ &\Rightarrow I_B > I_A \end{aligned}$$



12)

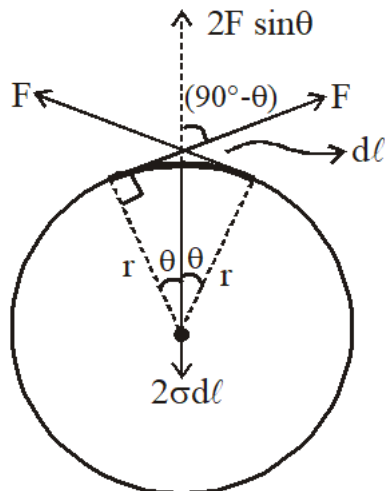
In a hydraulic press, a force F_1 applied to the smaller plunger (creates a pressure) (P_1/A_1) in the liquid and this pressure is transmitted equally throughout the liquid and acts on the larger plunger. The thrust acting on the larger plunger upwards due to this pressure is

$$F_2 = A_2 \left(\frac{F_1}{A_1} \right)$$

Hence, the thrust on A_2 magnified $\left(\frac{A_2}{A_1} \right)$ times

$$\frac{F_1}{A_1} = \frac{20}{5 \times 10^{-4}} = 40000 \text{ N/m}^2$$

$$13) 2F \sin \theta = 2\sigma dl$$



$$\Rightarrow F\theta = \sigma dl \text{ [for small } \theta, \sin \theta \approx \theta]$$

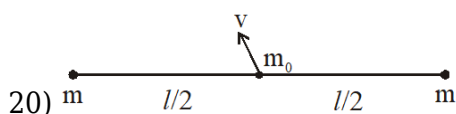
$$\Rightarrow F\theta = \sigma \cdot (2\theta r)$$

$$\Rightarrow F = 2\sigma r = 2\sigma \left(\frac{\ell}{2\pi} \right) \Rightarrow F = \frac{\ell\sigma}{\pi}$$

$$\text{now } Y = \frac{F/a}{x/\ell} \Rightarrow \frac{x}{\ell} = \frac{F}{aY} = \frac{\ell\sigma}{\pi aY}$$

14) To produce interference waves must have same frequency and constant phase difference. Here waves $y_2 = a \sin(\omega t - kx)$ and $y_3 = a' \sin(\omega t - kx + \phi_2)$ have equal frequency. Hence they will produce interference.

$$16) f = 5 \text{ and } u = \frac{f}{2} nRT = \frac{5}{2} \times 1 \times 8.3 \times 200 = 4150 \text{ J}$$



20) Gravitational potential energy

$$= \frac{-4Gmm_0}{\ell}$$

to escape, $\Delta KE + \Delta PE = 0$

$$= \left(0 - \frac{1}{2} m_0 v^2 \right) + \left\{ 0 - \left(-\frac{4Gmm_0}{\ell} \right) \right\} = 0$$

$$v = 2\sqrt{\frac{2Gm}{\ell}}$$

$$21) \text{LC } \frac{1\text{mm}}{200}, \frac{0.5\text{mm}}{400}, \\ 0.1 \text{ mm}, 0.2 \text{ mm}$$

$$22) v = \frac{kQ}{d}$$

$$23) I = neAV_d$$

$$V_d = \frac{I}{enA}$$

$$n = \frac{\rho}{M} \times N_A; \rho \text{ is density}$$

$$V_d = \frac{IM}{eA\rho N_A}$$

$$V_d = \frac{10 \times 63.5 \times 10^{-3}}{\frac{1.6 \times 10^{-19} \times 0.05 \times 10^{-4} \times 8.9 \times 10^3 \times 6 \times 10^{23}}{63.5 \times 10 \times 10 \times 10^{-6}}}$$

$$V_d = \frac{1.6 \times 5 \times 8.9 \times 6}{63.5 \times 10 \times 10 \times 10^{-6}}$$

$$V_d \simeq 1.5 \times 10^{-4} \text{ m/s}$$

24) Potential gradient in first case is

$$K_1 = \frac{\varepsilon_0}{\ell}$$

$$\therefore \varepsilon = K_1 \times \frac{\ell}{3} \Rightarrow \varepsilon = \frac{\varepsilon_0}{\ell} \times \frac{\ell}{3} = \frac{\varepsilon_0}{3}$$

In the second case

$$K_2 = \frac{\varepsilon_0}{\frac{3\ell}{2}} = \frac{2\varepsilon_0}{3\ell}$$

Potential gradient

$$25) \varepsilon = K_2 \ell' \Rightarrow \frac{\varepsilon_0}{3} = \frac{2\varepsilon_0}{3\ell} \ell' \Rightarrow \ell' = \frac{\ell}{2}$$

$$26) \text{ Use } \frac{B_{\text{axis}}}{B_{\text{centre}}} = \left(\frac{R^2}{R^2 + x^2} \right)^{3/2}$$

$$29) P = \frac{V_0^2}{2z^2} R = \frac{V_0^2 R}{2 \times 2R^2}$$

$$30) \frac{2E}{C} = mv \dots i$$

$$\text{COE } \frac{1}{2} mv^2 = mg\ell (1 - \cos \theta)$$

$$\frac{1}{2} \times \frac{4E^2}{m^2 C^2} = g\ell (1 - \cos \theta) = g\ell \frac{\theta^2}{2}$$

$$\therefore \theta = \frac{2E}{mC\sqrt{g\ell}}$$

47)

⇒ Penta-acetyl derivative of glucose indicates the open chain structure of glucose because when all five hydroxyl groups on the glucose molecule are readily acetylated, it shows the presence of five free hydroxyl groups, which is only possible in the open chain structure where each hydroxyl group is readily available for reaction.

⇒ Formation of stable penta acetate confirms the open chain structure of glucose.

PART-III : MATHEMATICS

$$61) \arg(z_1) = -\tan^{-1} 5/3$$

$$\text{and } \arg(z_2) = -\pi + \tan^{-1} \frac{5}{3}$$

$$\therefore \arg\left(\frac{z_1}{z_2}\right) = \arg(z_1) - \arg(z_2)$$

$$\Rightarrow \arg\left(\frac{z_1}{z_2}\right) = \pi - 2\tan^{-1} \frac{5}{3}$$

$$62) \frac{\int_1^2 1 dx + \int_2^3 2 dx}{3 \int_0^1 x dx} = \frac{1+2}{3/2} = 2$$

$$63) a \sqrt{2} = (1 + i)$$

$$\Rightarrow 2a^2 = 1 - 1 + 2i$$

$$\Rightarrow a^2 = i$$

$$\text{Thus } a^6 + a^4 + a^2 + 1$$

$$= i^3 + i^2 + i + 1$$

$$= -i - 1 + i + 1 = 0$$

$$64) \alpha\beta\gamma = -1$$

$$\left(\alpha - \frac{1}{\beta\gamma}\right) \left(\beta - \frac{1}{\gamma\alpha}\right) \left(1 - \frac{1}{\alpha\beta}\right)$$

$$= \frac{(\alpha\beta\gamma - 1)^3}{(\alpha\beta\gamma)^2} = \frac{(-1 - 1)^3}{(-1)^2} = -8$$

$$65) \int \left(\frac{1}{\cos 2x} + 1 \right) \tan x dx = \int \frac{(1 + \cos 2x)}{\cos 2x} \tan x dx$$

$$= \int \frac{2\cos^2 x}{\cos 2x} \times \frac{\sin x}{\cos x} dx = \int \frac{\sin 2x}{\cos 2x} dx = \int \tan 2x dx$$

$$= \frac{\ln(\sec 2x)}{2} + C$$

$$66) x^4 + x^2 + 2x + 1 = 0$$

$$\Rightarrow x^4 + (x + 1)^2 = 0$$

$$\Rightarrow x^4 = 0 \text{ and } (x + 1)^2 = 0$$

but both can not be hold for any value of x.

$$\begin{aligned} 67) I &= \int \frac{\sec x \cdot \operatorname{cosec} x}{2 \cot x - \sec x \operatorname{cosec} x} dx \\ &= \int \frac{dx}{2 \cos^2 x - 1} = \int (\sec 2x) dx \\ I &= \frac{\ln |\sec 2x + \tan 2x|}{2} + c \end{aligned}$$

68) Given that

$$(a + 3d) + (a + 6d) + (a + 9d) = 15$$

$$\Rightarrow 3a + 18d = 15 \Rightarrow a + 6d = 5$$

$\Rightarrow$ Sum of thirteen terms

$$= 13/2 [2a + 12d] = 65$$

$$70) \vec{r} \cdot \vec{a} = 27$$

$$4xy - xy - 3 = 27$$

$$xy = 10$$

$$(1, 0) (2, 5) (-1, -10) (-2, -5) \}$$

8 ordered pairs.

$$(10, 1) (5, 2) (-10, -1) (-5, -2)$$

$$72) E_1 \rightarrow \text{Throwing 2} \quad P(E_1) = \frac{1}{6} \quad P(\bar{E}_1 \bar{E}_2) = \frac{5}{12}$$

$$E_2 \rightarrow \text{Tossing a head} \quad P(E_2) = \frac{1}{2}$$

$$\begin{aligned} P &= P(\bar{E}_2 E_1 \cup \bar{E}_2 \bar{E}_1 \bar{E}_2 E_1 \cup \bar{E}_2 \bar{E}_1 \bar{E}_2 \bar{E}_1 \bar{E}_2 E_1 \dots) \\ &= P(\bar{E}_2 E_1) + P((\bar{E}_1)(\bar{E}_2) E_1) + P((\bar{E}_1)^2 (\bar{E}_2)^2 E_1) + \dots \\ &= \frac{\bar{E}_2 E_1}{1 - \bar{E}_1 \bar{E}_2} = \frac{\frac{1}{2} \cdot \frac{1}{6}}{1 - \frac{5}{12}} = \frac{1}{7} \end{aligned}$$

$$73) P(A \cap B) = P(A) \cdot P(B)$$

$$\Rightarrow P(\bar{A} \cap B) = P(B) - P(A \cap B)$$

$$= P(B) - P(A) \cdot P(B)$$

$$= P(\bar{A}) \cdot P(B)$$

$\Rightarrow \bar{A} \text{ \& } B \text{ are independent}$

74) Case-I :

a, b, c having exactly one 5 with :

(i) 2 even digits (different or same) :

$${}^4C_2 \cdot 3! + {}^4C_1 \cdot \frac{3!}{2!} = 48$$

(ii) one digit divisible by 4 and one odd :

$${}^2C_1 \cdot {}^4C_1 \cdot 3! = 48$$

Case-II :

a, b, c having exactly two 5 with :

$$(i) \text{ one digit divisible by 4 : } 2 \cdot \frac{3!}{2!} = 6$$

Hence number of ways = 102

$$75) \text{ Let } g(x) = ax + b \Rightarrow f(ax + b) = 6x - 7$$

$$\Rightarrow -2ax - 2b + 1 = 6x - 7$$

$$\Rightarrow b = 3, a = -3$$

$$76) f'(a) = f'(b)$$

$$3a^2 + a = 3b^2 + a \Rightarrow a = -b$$

$$\text{so } f(1) = 1 + a + b = 1$$

$$77) x + y = t - \frac{1}{t}, \quad x^2 + y^2 = t^2 + \frac{1}{t^2}$$

$$(x + y)^2 = t^2 + \frac{1}{t^2} - 2$$

$$x^2 + y^2 + 2xy = x^2 + y^2 - 2$$

$$\Rightarrow xy = -1 \Rightarrow y = -1/x$$

$$\Rightarrow y' = \frac{1}{x^2}$$

$$78) f(x) = 2\ln x - x$$

$$f'(x) = \frac{2}{x} - 1 > 0$$

$$\Rightarrow \frac{x-2}{x} < 0 \Rightarrow 0 < x < 2$$

$$80) f'(x) = x - \sin x$$

$$= \begin{cases} \text{positive} & \text{when } x > 0 \Rightarrow \text{increasing} \\ \text{negative} & \text{when } x < 0 \Rightarrow \text{decreasing} \end{cases}$$

$$81) 2x^2 + (\lambda - 3)y^2 + (\mu + 3)xy + 8ax + 12(1 - a)y - 42 = 0$$

$$\text{for circle : (1) } a = b \Rightarrow \lambda = 5$$

$$(2) \quad h = 0 \Rightarrow \mu = -3$$

equation of circle is

$$x^2 + y^2 + 4ax + 6(1 - a)y - 21 = 0$$

$$\text{radius} = \sqrt{4a^2 + 9(1 - a)^2 + 21} \leq 5$$

$$13a^2 - 18a + 5 \leq 0$$

$$a \in \left[\frac{5}{13}, 1 \right]$$

only integral value of a is 1.
hence integral value of $\lambda + \mu + a$ is 3.

82) clubbing all the terms

$$({}^1C_0 + {}^1C_1) + ({}^2C_0 + {}^2C_1 + {}^2C_2) + \dots + ({}^nC_0 + {}^nC_1 + \dots + {}^nC_n)$$

$$2^1 + 2^2 + \dots + 2^n = \frac{2(2^n - 1)}{(2 - 1)} = 2^{n+1} - 2$$

83) Let radii of bigger & smaller circle are r_1 & r_2

$$\Rightarrow r_1 + r_2 = 15 \quad \dots\dots(i)$$

$$\& \pi r_1^2 + \pi r_2^2 = 153\pi \quad \dots\dots(ii)$$

$$\Rightarrow r_1 = 1, r_2 = 3 \Rightarrow \frac{r_1}{r_2} = 4$$

$$84) \text{Coefficient of } x^9 = -(1 + 2 + 3 + \dots + 10) \\ = -55$$

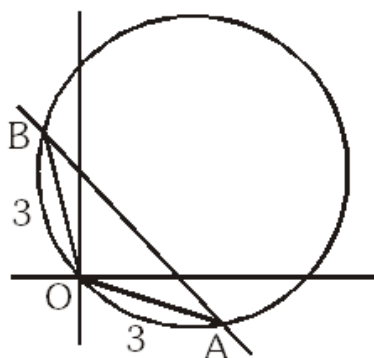
86) $T_{r+1} = {}^{100}C_r (\sqrt[4]{5})^{100-r} (\sqrt[7]{2})^r$ will be rational if $100 - r$ is a multiple of 4 and r is a multiple of 7.

Also $0 \leq r \leq 100$

$$\Rightarrow r = 0, 7, 14, 21, 28, 35, \dots, 98$$

But $100 - r$ is a multiple of 4.

$$\Rightarrow r = 0, 28, 56, 84 \text{ gives rational terms.}$$



87)

$$S : (x - 3)^2 + (y - 4)^2 = 25$$

$$S' : x^2 + y^2 - 6x - 8y = 0$$

$\therefore$ Origin lies on the circle. A & B are points on the circle at a distance 3 from origin. Equation of another

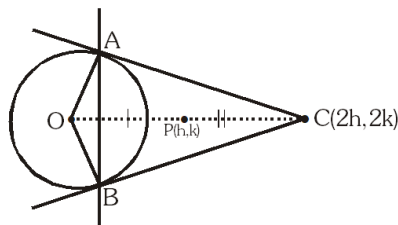
circle whose centre is $(0, 0)$ and radius is 3, is

$$S' : x^2 + y^2 = 9$$

$\therefore$ chord AB is, $S - S' = 0$

$$\Rightarrow 6x + 8y = 9$$

$$\begin{aligned}
88) \text{ We know that } (ABC)^{-1} &= C^{-1}B^{-1}A^{-1} \\
(A(A+B)^{-1}B)^{-1} &= (B^{-1})((A+B)^{-1})^{-1}A^{-1} \\
&= B^{-1}(A+B)A^{-1} \\
&= (B^{-1}A + B^{-1}B)A^{-1} = (B^{-1}A + I)A^{-1} \\
&= B^{-1}(AA^{-1}) + I A^{-1} = B^{-1}I + A^{-1} = B^{-1} + A^{-1}
\end{aligned}$$



$$\begin{aligned}
89) \quad OP &= PC \\
\text{Let } P(h, k) \\
\text{equation of AB is} \\
2hx + 2ky - 4 &= 0 \\
\text{on comparing with } \lambda x - y - 4 &= 0 \\
\frac{2h}{\lambda} = \frac{2k}{-1} = 1 \\
\Rightarrow k &= -\frac{1}{2}, \quad h = \frac{\lambda}{2} \\
\Rightarrow \text{Locus of } (h, k) \text{ is } y &= -\frac{1}{2}
\end{aligned}$$

$$\begin{aligned}
90) \quad AB &= I \Rightarrow |A||B| = 1 \\
\Rightarrow A, B &\text{ are non-singular} \\
\Rightarrow A^{-1}, B^{-1} &\text{ exists} \\
\Rightarrow B &= A^{-1} \\
\text{similarly} \\
P &= A^{-1}B^{-1} \Rightarrow P = BB^{-1} \\
P &= I \Rightarrow \text{unique solution}
\end{aligned}$$

$$\begin{aligned}
91) \quad \sin^2 x - \tan^2 x &= 1 \\
\Rightarrow t - \frac{t}{1-t} &= 1 \quad (\text{let } \sin^2 x = t) \\
\Rightarrow t^2 - t + 1 &= 0 \Rightarrow \text{No solution}
\end{aligned}$$

$$\begin{aligned}
92) \quad \text{Hint : } B &= A^{-1} \\
\Rightarrow AB &= I \Rightarrow 10AB = 10I
\end{aligned}$$

$$\begin{aligned}
93) \quad \text{Expand} \\
1 + \sin^2 \alpha \sin^2 \beta + 2 \sin \alpha \sin \beta - \sin^2 \alpha - \sin^2 \beta - 2 \sin \alpha \sin \beta \\
(1 - \sin^2 \alpha) + \sin^2 \alpha \sin^2 \beta - \sin^2 \beta \\
= \cos^2 \alpha - \sin^2 \beta \cos^2 \alpha = \cos^2 \alpha \cos^2 \beta
\end{aligned}$$

$$\begin{aligned}
94) s &= \cos\left[\frac{\pi}{4} + \frac{1}{2}\cos^{-1}\left(\frac{a}{b}\right)\right] + \cos\left[\frac{\pi}{4} - \frac{1}{2}\cos^{-1}\left(\frac{a}{b}\right)\right] \\
s &= 2 \cdot \cos\frac{\pi}{4} \cos\left[\frac{1}{2}\cos^{-1}\left(\frac{a}{b}\right)\right] \\
&= \sqrt{2} \cdot \cos\frac{\theta}{2} \\
\text{where } \theta &= \cos^{-1}\frac{a}{b} \Rightarrow 0 \leq \theta \leq \pi \\
\Rightarrow \cos\theta &= \frac{a}{b} \\
\Rightarrow 2\cos^2\frac{\theta}{2} &= \frac{a+b}{b} \\
\Rightarrow \cos\frac{\theta}{2} &= \sqrt{\frac{a+b}{2b}} \quad \left\{0 \leq \frac{\theta}{2} \leq \frac{\pi}{2}\right\} \\
\therefore s &= \sqrt{\frac{a+b}{b}}
\end{aligned}$$

$$\begin{aligned}
95) \text{ Given that } 5^{1+\log_5 \cos x} &= \frac{5}{2} \\
\Rightarrow 1 + \log_5 \cos x &= \log_5 \left(\frac{5}{2}\right) \\
\Rightarrow \log_5 5 + \log_5 \cos x &= \log_5 5 - \log_5 2 \\
\Rightarrow \log_5 \cos x &= -\log_5 2 \\
\text{or } \cos x = 2^{-1} &\Rightarrow x = 2n\pi \pm \frac{\pi}{3}, n \in \mathbb{I}
\end{aligned}$$

$$\begin{aligned}
96) \sin^{-1} x &= \sqrt{\cos^{-1} x} + \frac{\pi}{2} \\
\Rightarrow -\cos^{-1} x &= \sqrt{\cos^{-1} x} \\
\Rightarrow \cos^{-1} x &= 0 \\
\Rightarrow x &= 1
\end{aligned}$$

$$\begin{aligned}
97) 6\cos^5\theta - 6\cos^4\theta - 5\cos^3\theta + 5\cos^2\theta + \cos\theta - 1 &= 0 \\
\Rightarrow 6\cos^4\theta(\cos\theta - 1) - 5\cos^2\theta(\cos\theta - 1) + (\cos\theta - 1) &= 0 \\
\Rightarrow (\cos\theta - 1)\{6\cos^4\theta - 5\cos^2\theta + 1\} &= 0 \\
\Rightarrow (\cos\theta - 1)(3\cos^2\theta - 1)(2\cos^2\theta - 1) &= 0 \\
\cos\theta = 1; \cos\theta = \pm\frac{1}{\sqrt{3}}; \cos\theta = \pm\frac{1}{\sqrt{2}} \\
\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ 0 & 4 & 4 \end{array} \\
\Rightarrow 8 \text{ solutions}
\end{aligned}$$

$$\begin{aligned}
98) \text{ Domain of } \sin^{-1}x &\text{ is } [-1, 1] \\
\text{domain of } \operatorname{cosec}^{-1}x &\text{ is } (-\infty, 1] \cup [1, \infty) \\
\text{common domain is } &\{-1, 1\} \text{ only} \\
\text{range} = \sin^{-1}(-1) + \operatorname{cosec}^{-1}(-1) &= -\pi \\
= \sin^{-1}(1) + \operatorname{cosec}^{-1}(1) &= \pi
\end{aligned}$$

$$99) \text{ As } \sin^{-1}(x^2) = \cos^{-1}x \Rightarrow x > 0$$

$$\sin^{-1}(x^2) = \sin^{-1} \sqrt{1-x^2}$$

$$\Rightarrow x^4 + x^2 = 1$$

PART-IV(A) : English Proficiency

101) Explanation: Option 'b' is the correct answer because GALE means outburst of laughter whereas CALM means still or tranquil.

102) Explanation: Option 'd' is the correct answer because ANARCHY means lawlessness or state of disorder, and government means administration or place where authorities are present to govern over a country.

103) Explanation: Option 'c' is correct because the sentence is in Present Perfect tense which takes 'has or have' as helping verbs. In Present Perfect Tense the action takes place somewhere in past, and to give emphasise on that action in present, we use Present Perfect Tense.

104) Explanation: Option 'a' is correct because Past Perfect Tense describes an action that takes place before the other action in a sentence. It is the basic rule of tenses that if simple past is used in the first clause, past perfect tense will be used in the second clause of the sentences or vice-versa. In the sentence the students had already marked the answers (action 1) before the teacher collected the sheets (action 2).

105) Explanation: Option 'd' is the correct answer because wily, canny, and shrewd have the same meaning i.e. skilled at deceitfully gaining advantage, but outspoken means frank or honest in giving opinions.

106) Explanation: Option 'd' is the correct answer because ceaseless, continual and non-stop have the same meaning i.e. never-ending or constant, but transitory means temporary.

107) Explanation: Option 'c' is the correct answer because in question tag the sentences that start with "let's" take shall in the tag. The basic rule of question tag i.e. if the first clause is positive, the second clause (tag) will be negative, does not apply in this case.

108) Explanation: Option 'c' is the correct answer because in question tag sentences that have 'am' as helping verb take are in tag. It's the basic rule of question tag that if the first clause is positive the second clause (tag) will be negative.

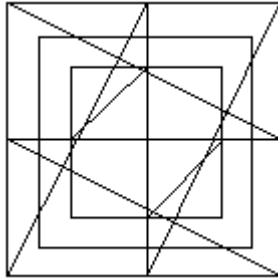
109) Explanation: Option 'b' is the correct answer because when a number and measurement unit are acting as an adjective in a sentence, the measurement unit is not written as plural, which is the case here.

110) Explanation: Option 'b' is the correct answer because - Latter is used when we have two nouns and last is used for more than two nouns, which is the case here.

PART-IV(B) : Logical Reasoning

111) Explanation: 'Caw' is the sound produced by crows and 'click' is the sound produced by dolphins. Therefore Option C is correct.

112) Explanation: Following is the complete pattern. Therefore Option B is correct.



113) Explanation: Option C is correct.

The given series is a compound series made by the combination of following simple series.

I. 1, 5, 14, 30, 55

First digit=1

First digit=1+22 = 5

First digit=5+32 = 14

First digit=14+42 =30

First digit=30+52 =55

II. 1, 6, 16, 36, 76, ?

First digit= 1

First digit= 1+ (5x1)= 6

First digit= 6+ (5x2) = 16

First digit= 16+ (5x4) = 36

First digit= 36+ (5x8) = 76

Missing digit= 76+ (5x16) = 156

114) Explanation: Except 'Grey', all others are the names of rivers. Therefore Option D is correct.

115) Explanation: Option C is correct. Figure X has been sliced diagonally and the two sliced parts are placed one over the other after being rotated 45O clockwise.

116) Explanation: A 'square' is placed in each block of the given matrix. The third image in each column contains only the line(s) which are common in both the first two blocks of that column. Therefore Option A is correct.

117) Explanation: The number in each of the four squares is the sum of numeric value of all

the three alphabets in that square. Therefore Option C is correct.

118) Explanation:

Third letter of the fourth word from the right

= MAD

Second letter of the second word from the left = ASH

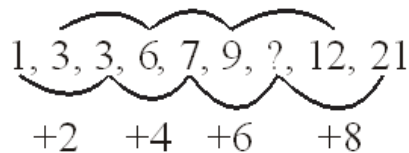
Number of alphabets between M and S = 5

Therefore Option B is correct.

119) Explanation: Except 'spoon', all others are crockery items.. Therefore Option C is correct.

121) $0+1\times6=6$, $6+3\times6=24$, $24+6\times6=60$, $60+10\times6=120$,

$120 + 15 \times 6 = 210$, $210+21\times6=210+126=336$



122)

Alternative term from 1

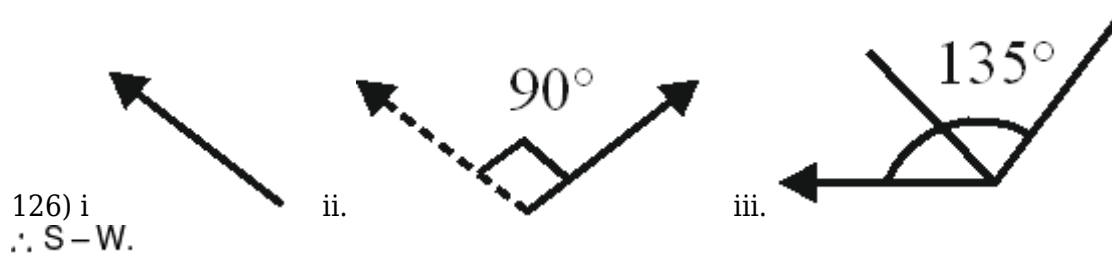
$1 + 2 = 3$, $3 + 4 = 7$, $7 + 6 = \underline{13}$, $13 + 8 = 21$.

123) Teacher is called clerk then clerk will teach in a class.

125) Logic: $\frac{3}{3} + \frac{9}{3} = 1 + 3 = 13 = 31$

$\frac{15}{3} + \frac{12}{3} = 5 + 4 = 54 \Rightarrow 45$

Similarly : $\frac{12}{3} + \frac{27}{3} = 4 + 9 = 49 \Rightarrow 94$



126) i
 $\therefore S - W$.

127) $\frac{25+17}{7} = 6$

$\frac{38+18}{7} = 8$

$\frac{89+16}{7} = 15$

$$128) 2 \times 3 \times 5 = 30$$

$$5 \times 1 \times -1 = -5$$

$$6 \times 3 \times -1 = -18$$